WOODWORKING METHOD AND APPARATUS

Related Applications

This is a continuation-in-part of US application No. 09/714262 filed November 17, 2000, now abandoned.

Field Of The Invention

This invention relates to a method and apparatus for cutting material and joining material and particularly relates to a method and apparatus for cutting and joining wood utilizing a tool having an abrasive sleeve, said tool having in one embodiment a bearing surface following a template for cutting said wood, and said tool having in another embodiment an abrasive sleeve adhering to a cylindrical body by a solvent-free adhesive.

Background Art

Various devices and methods have heretofore been designed and utilized for cutting and joining materials together such as wood or the like. Routers, drills, table saws, scroll saws as well as other machines and tools may cut these materials.

For example U.S. Patent No. 5,114,265 relates to an interlocking joint for joining two panels together having curved jigsaw shaped indents and protrusions on edges of both panels that fit together and can not be pulled apart. The indents and protrusions are cut by a router with a straight-sided cutter. A template is provided for guiding a bushing on a cutter shaft of a router and the template takes into account the bushings having a larger diameter than the cutter. There is also a jig provided that has fingers that are assembled to cut out the interlocking joint with a router. Furthermore U.S. Patent No. 5,114,265 utilizes a template which takes into account a bushing having a larger diameter than the cutter, where the cutter bites into the wood and thereby provides relatively inaccurate means of cutting the materials.

U.S. Patent No. 5,267,593 teaches a spindle arranged for mounting cutters to an

associated router configured to include a lower shaft co-axially aligned with an upper shaft having an abutment collar therebetween. An upper threaded boss mounts a fastener assembly to secure and position the sharper cutter between the abutment cutter and the upper shaft threaded boss.

Other arrangements are shown in U.S. Patent No. 5,038,636, which relates to a jig and workpiece transport mechanism for making a curvilinear cut with a conventional band saw which continuously linearly translates and rotationally reorients a jig and an attached workpiece to maintain the saw line on the cutting edge in the workpiece aligned with the band saw blade.

Yet another arrangement is shown in U.S. Patent No.1, 948,266 which relates to a holder for an abrasive stick comprising a hollow supporting member terminating in a tapered end portion, said member being longitudinally slitted whereby to render it compressible and said tapered end portion having a bayonet slot therein, and means fitted over the tapered end portion compressing the tapered end to retain an abrasive stick therein, the means includes an element adapted to co-operate with the bayonet slot to retain said means fitted over said tapered end.

Furthermore U.S. Patent No. 5,682,935 relates to a template utilized in conjunction with a rotating cutting tool such as a router bit to form a self-mating repeating interlocking pattern in the edge of a workpiece. The template has a body having an elongated edge having a plurality of notches formed therein. Each notch as two sides and an innermost edge, the notches being spaced along the elongated edge at equal intervals. Each notch has at least one S-shaped side, which has an outer curved portion and an inner curved portion, the radius of the inner curved portion being equal to three times the radius of the outer curved portion. The rotating cutting tool is spaced apart from the elongated edge of the template by a distance equal to the radius of the outer curved portion of the S-shaped sidewall so that as the cutting tool is guided along the edge of the template an interlocking self-mating pattern is formed in the workpiece edge.

Other arrangements are shown in U.S. Patent No.4, 405,004 which teaches a dovetail fixture for guiding a cutting tool and cutting mortises and tenons while U.S.

Patent No. 4,607,673 relates to a dovetailed fixture for clamping and holding two workpieces and for guiding a cutting tool whereby mortises are cut in one workpiece and tenons are concurrently cut in the other piece.

Further, U.S. Patent No. 5,193,596 relates to a pattern cutting assembly having a pattern guide member used to co-operate with a pattern and a workpiece holding frame which in turn has a workpiece member mounted thereon and used in conjunction with a rotating blade, such as a router blade or a scroll saw blade, to cut a predetermined accurate pattern within the workpiece member.

Finally, European Patent Publication No. 0,035,939-A1 describes a cylindrical grinding drum which grinds a workpiece in accordance with a pre-set design on a jig attached to a workpiece. This device is used to create roughly equivalent designs for use on, for example, door mouldings, or the like.

These and other prior art devices and apparatus present relatively complicated methods and apparatus, which do not provide consistent and accurate reproducible methods of cutting and joining materials together. In particular, these devices do not provide the straight, repeatable, vertical cuts necessary for joining workpieces together in, for example, an inlay application where tolerances between the vertical workpiece surfaces are measured in thousands of an inch. This is true not only in abutting application where two pieces are placed side by side, but is particularly true in situations where one piece is fitted completely within a second, surrounding piece.

As such, the difficulties with prior art devices can be summarized as follows. Routers have high rotational speeds which can be dangerous for untrained hobbyist, and the router blades have cutting edges which "chop" wood chips from the workpiece. It is difficult to achieve a precise cut using this technique. Belt and drum sanders remove material from the workpiece but typically they are held on flexible surfaces which move as pressure is applied. Grinding wheels have an abrasive material which grinds away at the workpiece. However, the media of the grinding wheel abrasive is constantly being worn off the surface of the grinding wheel, and thus it is difficult to achieve a constantly flat vertical grinding surface. Other options include saws with small blade such as scroll saws,

however, scroll saws utilized in the prior art have cutting blades which reciprocate up and down but tend to wander from side to side.

It is an object of this invention to provide an improved method and apparatus for cutting materials such as wood or the like, as well as joining material such as wood or the like.

It is a further object of this invention to provide improved tools for use in association with said method and apparatus which include improved means for accurately cutting said materials.

Disclosure of Invention

It is an aspect of this invention to provide a tool for milling materials said tool having a cylindrical portion and an abrasive cylindrical means, and a solvent-free adhesive intermediate said cylindrical portion and said abrasive cylindrical portion.

It is another aspect of this invention to provide a method for joining two materials together comprising providing guiding means for guiding a shaping means for shaping said materials, and joining said materials together.

It is a further aspect of this invention to provide a tool adapted to contact a template for shaping materials to a desired shape comprising a body having means for connection to means for revolving said tool; abrasive cylindrical means removably securable to said body; and means for contacting said template for shaping said material.

It is yet another aspect of this invention to provide a method of joining a first piece of material having a selected shape to a second piece of material having a second selected shape which registers with said first selected shape comprising cutting a first and second template having selected first and second shapes; securing said first and second templates to first and second materials where said first and second materials peripherally extend beyond said first and second templates respectively so as to define excess material; removing said excess material from said first and second material with a tool having a cylindrical portion, an abrasive tube having an internal diameter registrable with said cylindrical portion, cylindrical shoulder for rotating contact with said template whereby

said abrasive tool removes said excess material as said cylindrical shoulder contacts and moves along the peripheral edge of said template and thereby produce said materials having selected registrable shapes.

Brief Description of the Drawings

Fig. 1 is a top plan view illustrating one embodiment of the invention.

Fig. 2 is a top plan view of a template.

Fig. 3 is a top plan view of a template.

Figs. 4a and 4b are top plan views of wood to be shaped.

Fig. 5 is a perspective view of a drill press where the top integral bearing of the tool engages a template.

Fig. 6 is a perspective view of a drill press where the bottom integral bearing of the tool engages a template.

Fig. 7 is a perspective view of a router where the top integral bearing of the tool engages a template.

Fig. 8 is a perspective view of a router where the bottom integral bearing of the tool engages a template.

Fig. 9 is an exploded view of the tool.

Fig. 10 is an exploded view of another embodiment of the tool.

Fig. 11 is an exploded view of another embodiment of the invention.

Fig. 12 illustrates a tool with a scroll saw.

Fig. 13 is an exploded view of another embodiment of the tool.

Best Mode for Carrying Out the Invention

In the description that follows, like parts are marked throughout the specification and the drawings with the same respective reference numerals. The drawings are not necessarily to scale and in some instances proportions may have been exaggerated in order to more clearly depict certain features of the invention.

Figure 1 shows an example of a desired finished product, which can be produced in

accordance with the method and apparatus to be described herein. An inlay 2 having a desired shape may be comprised of a suitable material such as oak or the like which is to be inlaid into another material such as maple 4. The invention to be described herein can be utilized to produce any desired shape and the example shown in Figure 1 herein is shown for illustrative purposes only and shall not be construed to limit the invention herein. For example the method and apparatus can be utilized for inlays, marketry, intarsia, or the like.

Further, while the invention is described with respect to applications using wood, it is also applicable to other materials which can be ground such as plastics or even ceramics or glass.

In order to produce a desired pattern as shown in .Figure 1 a guiding means 6 such as a template or pattern must first be produced as shown in Figures 2 and 3. The inlay 2 will be produced by a template or guiding means while the receiving wood 4 will be produced by the template or guiding means 8.

Thc templates 6 and 8 are produced from a material, which is easily cut but durable enough to guide a tool to be partictJfarized herein. Suitable materials consist of door skin material, veneer, arborite or the like. In one embodiment one can overlay the door skin material with arborite or the like so as to give the pattern rigidity and long lasting qualities. The template 6 is cut from such door skin material or veneer by suitable means such as a scroll saw (not shown); and the template 6 will correspond to the desired shape. Furthermore the template 8 is also cut from the door skin material by suitable means such as a scroll saw (not shown) or the like. The templates 6 and 8 may by way of example be cut in a scroll saw by utilizing a Olson™ universal #5 blade (which is 0.016 thick and 0.038 inch width) so that the templates 6 and 8 are accurately cut to close tolerances.

Thereafter a rough-cut of the inlay 2 may be cut from a piece of material such as oak 12 as shown in Figure 4a. The rough cut of the material 14 is again cut in a suitable saw such as a scroll saw (not shown) so that the exterior extent of the rough cut 14 is slightly larger than the desired finished shape 2 as represented by the phantom lines in Figure 4a.

Thereafter the template 6 is attached to the rough cut 14 and secured thereby by suitable means such as double sided tape or the like. The doublesided tape will firmly secure the template or pattern 6 to the rough cut 14 representative view of which are shown in Figures 5 and 6.

Figures 5 and 6 also illustrate a suitable machine such as a drill press which may be utilized in order to shape the rough cut 14 and produce the inlay 2. However one should appreciate that other machines may also be used such as a router disclosed in Figures 7 and 8, where the speed of router or other is less than 2000 rpm, and preferably 1725 rpm.

The typical drill press shown in Figures 5 and 6 includes a table 16 which will support the rough cut 14 and the template 6. As described previously the template 6 is firmly secured to the rough-cut 14 by suitable means such as double-sided tape sandwiched between the template 6 and rough-cut 14. Thereafter the template 6 double-sided tape (not shown) and rough-cut 14 may be moved in unison relative to the top of the table 16. The table 16 includes a suitable hole 18, which is adapted to receive the ,shaping tool tobe described herein. The shaping tool 20 is illustrated in the exploded view shown in Figure 9.

The shaping tool 20 comprises a shaping means 22 which consists of a cylindrical hollow tube having an abrasive surface 24 that is adapted to be received by the shaping tool body 26. In particular the shaping tool body 26 includes a first cylindrical portion 28, which has an internal threaded hole 30 at one end 32 thereof. The first cylindrical portion 28 is adapted to be tightly received within the hollow tube of the cylindrical tube of abrasive 24 as shown by the arrows in Figure 9, where the internal diameter is treated with a solvent-free compound before the abrasive cylinder is installed unto the cylinder portion 28 of the body of the tool so as to stop the abrasive cylinder from skating relative the body. A solvent-free compound is used so that once the abrasive cylinder is spent or used the abrasive cylinder may be easily removed. An example of a solvent-free compound is contact cement; but other solvent-free compounds could be used .

The outside diameter of the first cylindrical portion 28 and the inside diameter of the tube 24 is closely toleranced so that the first cylindrical portion 28 when treated with

the solvent-free compound referred to earlier fits snugly and tightly within the inner diameter of the tube 24. Thereafter a cylindrical end cap 34 is firmly secured to the first cylindrical 28 in a manner whereby the abrasive tube 24 is disposed between the end cap 34 and shoulder 36 so as to secure the shaping means 22 between the end cap 34 and shoulder 36. The end cap 34 is cylindrical in shape and includes a protruding cylindrical extension 38 which is adapted to be received within the counter bore 40 disposed at one end of the first cylindrical portion 28. This ensures that the end cap 34 is co-axially disposed about the central axis 42 of the tool 26. Suitable means such as a screw 44 is then utilized so as to secure the abrasive tube 24 between the end cap 34 and shoulder 36. The end cap 34 defines an integral bearing surface.

Figure 6 illustrates the assembled tool shown in Figure 9.

The tool shown in Figures 6 and 9 is superior to the cutter disclosed in U.S. Patent No. 5,114,265.

The shaping means 22 comprises an abrasive material such as silicon carbide or the like having a grit which can range from 24, 36, 50, 80-100 as well as 100-150 or more.

Moreover the outside diameter of the end cap 34 and shoulder 36 define an integral bearing surface and are dimensioned so as to be identical or substantially the same. Furthermore the outside diameter of the integral bearing 24 is:

(a) oversize - which means that the- outside diameter of the abrasive cylinder 24 is less than the outside diameter of end cap 34 and shoulder 36; or

(b) flush - the outside diameter of the abrasive cylinder 24 is substantially the same as the outside diameter of end cap 34 and shoulder 36.

The lower integral bearing is available with an oversize bearing which compensates blades thickness used in cutting patterns. For example if an Olson #5 blade is used the thickness of the blade and hence the keef is 0.016 thick, the oversize bearing is then made to correlate with the blade thickness, ie the outside diameter of the integral bearing is 0.016 larger than the outside diameter of the abrasive cylinder, that is the radius

of the integral bearing is 0.008 larger, so as to compensate for the blade thickness. This allows one to obtain substantially a mirror image of the insert 2 with material 4.

One will utilize the oversize tool on the pieces, ie the piece being inserted 2 or the piece receiving 4 the insert 2 or vice versa, but not both when using an insert.

Generally speaking the coarse grit sizes such as 50 or finer are used with an oversized integral diameter since these gritsizes will be used to further shape or mill the rough cut 14 so as to "mill" the oversize9 shape of the rough cut 14 to the desired shape 2 in a manner to be described herein. Furthermore the finer grit sizes such as 80-100 are generally flush since they will be used to finely mill the oversized material 14 to the desired shape 2 in a manner which shall now be described.

The assembled tool 20 also includes a mandrel 42, which is designed to be received by the chuck 46 of the drill press 48 as shown in Figure 6. A 1/2 inch chuck will receive a 1/2, 3/8, 1/4 mandrel or any mandrel less than 1/2 inch. In the example shown in Figure 6 the template 6 is adjacent the tabletop 16 while the rough-cut 14 is disposed above the template 6. In such arrangement the end cap 34 is adapted to eventually contact the peripheral edge of template 6 as a person manipulates the template 6 which is stuck to rough cut 14 and slidingly moved along the top of the table 16. At the same time the shaping means 20 revolves at a suitable speed such as for example' between 500 and 2000 rpm and preferably between 1725 and 2000 rpm so that the abrasive cylinder 24 mills the perimeter of the rough-cut 14. In the arrangement shown in Figure 5 the integral bearing 34 eventually contacts the peripheral edge of the template 6. Since the integral bearing 34 is comprised of material such as brass or the like the abrasive surface 24 will no longer bite into the rough-cut 14. Thereafter the template and rough cut 14 is manipulated so that the shaping tool 20 shapes the rough cut 14 to the desired shape 2 which corresponds to the template 6.

Depending on the amount of material to be shaped the excess material 50 which is represented as the material located between the peripheral edge 14 and 2 shown in Figure 4 one may utilize a coarse grit or a fine grit as outlined above.

Figure 5 is a representative view, which operates in a manner similar to that shown

in Figure 6 except that now the shoulder 36 is utilized to contact the peripheral edge of the pattern or template 6.

Figures 7 and 8 are representative views, which operate in a manner similar to that described in Figures 5 and 6 but in relation to a router. Generally speaking the router rotates at much higher speeds than drill presses and therefore it will be appropriate to step down the rpms to a suitable range. However the invention is not limited to any rpm and higher or lower speeds may be utilized, so long as the pressure applied to the material being handled will not overheat the tooling. Preferably the rpm is operable between 1725 and 2000.

Moreover a variety of different radiused tools 20 may be utilized depending on the desired shape and intricacy of the material to be milled. For example a variety of different sized tools may be used such that the outside diameter of the integral bearing 34 and 36 may be for example one inch in diameter, 3/4 inch, 5/8 inch, 1/4 inch, 1/8 inch or the like. However smaller or larger sizes can be used including oversize.

Furthermore once the rough cut material 14 is shaped to the desired shape 2 one may separate the template 6 from the inlay 2 by means of prying with a knife edge or the like. Thereafter another desired shape may be produced. For example one may cut the piece 8 from a piece of material 13 as shown in Figure 4b whereby the hole 15 is cut slightly smaller than the desired shape 4. In this case the tool 20 will be inserted into the recess 17 and used to mill the material to the desired shape 4 by removing the excess material 51 defined by the material between the rough cut 17 and the desired shape 4

Thereafter the inlay 2 may be inserted into the material 4.

In the process described above the template 6 is cut from the piece of door skin material such as veneer or the like as described above such that the remaining piece 8 defines the other desired shape. In this case one ensures that the inlay 2 will fit tightly within the material 4 since the two are cut at the same time particularly when utilizing a #5 blade. Since the template 6 and 8 fit snugly with one another the inlay 2 fits snugly within the material 4.

Although the template material has been described in relation to door skin material

or the like which is approximately 3/16 of an inch thick, other suitable material can be used so as long as the templates produce a stiff durable peripheral edge whereby the integral bearings 36 and 34 contact.

Furthermore the shapes illustrated in the drawings are for illustrative purposes only and may include any desired shape such as two sinusoidal pieces contacting one another. Furthermore two straight edges may be produced by utilizing the method and apparatus described herein so as to produce substantially perfect abutting edges that may be glued together.

Once the inlay 2 and material 4 have been cut and shaped as described above suitable sealants and adhesive may be utilized so as to permanently glue the inlay 2 into the material 4. The method and apparatus described herein produce substantially clean flush fitting pieces.

In the embodiment of tool shown in Figure 9 the bearing surface 36 may be flush as described while the bearing surface 34 is oversize as described; alternatively bearing surface 34 may be flush while bearing surface 36 oversize; or both bearing surfaces 36 and 34 being flush or oversize as required.

Moreover Figure 10 illustrates another embodiment of the tool 20 which includes only one bearing surface 36, cylindrical body portion 28 and abrasive cylinder 22. The tool 20 shown in Figure 10 operates in the same fashion as the tool disclosed in Figure 9 except only one bearing surface is utilized. The abrasive cylinder 22 is secured to the cylindrical portion 28 by means of a solvent-free adhesive or compound so as to prevent skating of the cylinder 22 relative to the body 28 during normal rotation of the tool in the drill press or router as described above. Again once the abrasive surface 22 is spent the abrasive may be easily removed by notching one end. of the abrasive 22 and unraveling the cylindrical surface 22 from around the bronze cylindrical body 28. Any remaining solvent-free compound on the cylindrical portion 22 may easily be removed by firmly wiping the cylindrical surface since it does not permanently bond to the surface 28 as in case of a solvent-based compound. The solventfree compound tends to remain flexible yet sufficiently adherent between the abrasive surface 22 and the body portion 28 so as to

prevent skating under normal operating conditions. If one tends to ram the abrasive cylinder 22 against the wood with great force it would likely cause either ripping abrasive surface 22 or skating of the abrasive surface 22 relative to the body 28, and this must be avoided.

It should be noted, though, that while the tool may be may of bronze, it may be made of other rigid materials such as brass, aluminum, steel or the like. The rigidity of the cylindrical body portion is important in order that a smooth, flat vertical surface is maintained, and that there is essentially no flexing of the cylindrical body as the workpiece is ground. A further important feature of the tool construction is the amount of "run-out" of the cylindrical body portion 28 and bearing surfaces 34 and 36. "Run-out" for the purposes of the present application is used to describe the "side to side" movement of the apparatus surfaces as the tool is rotated. For the cylindrical body portion and preferably for the bearing surfaces, the run-out is less than 5 thousands of an inch, more preferably less than 3 thousands of an inch, and most preferably less than 1 thousands of an inch. This run-out can be measured using a micrometer as the tool is rotated.

This amount of run-out is far less than prior art devices available to hobbyist, and as a result, the ground surface of the workpiece is cut to extremely accurate measurements, and the template is followed to an extremely high degree of accuracy. With the combined features of the flat vertical surfaces being cut to extremely accurate measurements with little run-out, and the template being very closely followed, the resulting cut pieces can be fit closely together with extremely small tolerances.

It should be again emphazied that this result is achieved using a low speed device such as a drill press. Further, it should be clear that the tool is connected directly to the drill press motor (through a chuck), and as such the run-out of the tool is not adversely affected by factors such as additional bearing surfaces, drive belts or the like.

Moreover figure 11 illustrates another embodiment of the tool 60 which may be utilized in association with a scroll saw 62. More particularly the tool 60 comprises of a cylindrical body portion 64 having a first outside diameter. The opposite ends of the cylindrical body portion 64 include a first cylindrical extension 66 and a second cylindrical

extension 68. Cylindrical portions 64, 66, and 68 are co-axially orientated as shown. In the embodiment shown in Figure 11 the cylindrical extensions 66 and 68 are fixed relative to the central body portion 64. The tool 60 also includes an abrasive tube 70 which is hollow having an inside diameter which is adapted to firmly slide against the outside diameter of the cylindrical body portion 64. As in the case of tool 20 a solvent-free compound is applied to the inside diameter of abrasive cylinder 70, or to the outside diameter of body portion 64 and the two pieces are slid one over the other so that the abrasive cylindrical portion 70 overlays the cylindrical body portion 64. Once the solvent has sufficiently secured the abrasive cylindrical portion 70 to the body portion 64 both extension 66 and 68 may be secured to the scroll saw as shown in Figure 12. Thereafter as the scroll saw reciprocates up and down the abrasive surface 70 can be utilized to mill desired surfaces in an accurate and efficient manner.

Since the tool 60 comprises of a rigid structure the tool 60 may mill desired shapes without wandering as in the case of blades which are heretofore utilized with scroll saws.

Moreover figure 13 is a partial view of another embodiment of the tool as shown in Figure 11 except that both extensions 66 and 68 are adapted to freely rotate relative to the body portion 64 in the following manner. In particular opposite ends of the cylindrical body portion 64 each include an annular recess 72 which are adapted to receive a rotationally sliding cylindrical portion 74 having an annular groove 76. . The extension 66 is fixedly secured to the cylindrical portion 74. Moreover the outside cylindrical surface of the cylindrical body portion 64 includes a hole 78 which is adapted to receive a pin 80 or the like. The pin 80 is designed so as to extend into the annular groove 76 and permit the cylindrical portions 74 to radially rotate about the axis 82. Both ends of the embodiment shown in Figure 3 include a similar structure. Moreover the tool as shown in Figure 3 also includes the abrasive cylindrical surface 70 which adheres to the outside of the cylindrical body 64 by means of a solvent-free compound. Thereafter the tool as shown in Figure 13 may be attached to a scroll saw in a similar fashion as that shown in Figure 12. As the tool shown in Figure 13 reciprocates up and down in the scroll saw the abrasive surface 70 along with the cylindrical body portion 64 will tend to rotate about the axis so as to present

a fresh surface for milling a piece of material.

Advantages which are realized by utilizing the invention described herein include:

1. shaping or milling tools 'which do not bite into or rip the material as may be experienced in the cutter disclosed in U.S. Patent No. 5,114,265;
2. fine intricate fitting parts may be produced by utilizing abrasives having finer and finer grits;
3. the abrasive surface may be easily changed if worn;
4. smaller diameter shaping tools may be utilized for intricate shapes;
5. method and tools utilized herein are versatile and may be used to produce two mating straight edges, two irregular shapes or inserts;
6. the tool utilized herein produces smooth accurate shapes for both shaping parallel to the grain or cross-grain.

Suitable abrasives are silicon carbide or diamond grit.

Various embodiments of the invention have now been described in detail. Since changes in and/or additions to the above-described best mode may be made without departing from the nature, spirit or scope of the invention, the invention is not to be limited to said details.

Although the preferred embodiment as well as the operation and use have been specifically described in relation to the drawings, it should be understood that variations in the preferred embodiment could be achieved by a person skilled in the trade without departing from the spirit of the invention as claimed herein.